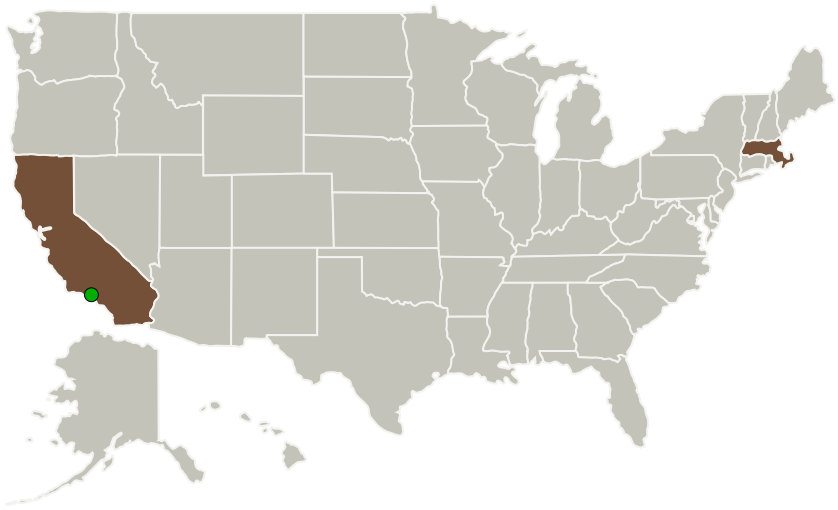
Femto-satellite Swarm State and Density Estimation, Phase I

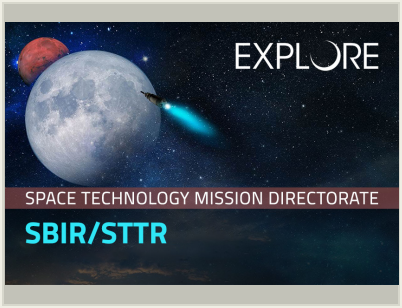
Completed Technology Project (2012 - 2012)

Project Introduction

NASA is planning future missions involving fleets of small satellites in LEO and GEO that can exhibit autonomous collective behavior. Such a "swarm of femto-satellites" can complete complex tasks that are difficult or impossible for large single satellites to achieve. Swarm state estimation can be achieved using the available GPS measurements, and local range and bearing measurements between the satellites. Due to the large size of the swarms and processing constraints on-board each femto-satellite, distributed estimation algorithms are necessary for successful implementation of estimation algorithms. However, measurements of range and bearing are nonlinear and couple the states of neighboring satellites, hence requiring nonlinear filtering algorithms that complicate the process of decentralizing the estimator. The objective of this project is to determine efficient estimator architectures and algorithms for distributed state estimation of femtosat swarms in LEO. SSCI has designed estimators and performed trade studies for unbounded swarms in deep-space as part of a DARPA study at NASA JPL. The proposed Phase-I project extends our previous works to state estimation for bounded swarms in LEO where swarm dynamics are nonlinear.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Scientific Systems Company, Inc.	Lead Organization	Industry Small Disadvantaged Business (SDB)	Woburn, Massachusetts
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

February 2012: Project Start

August 2012: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138160)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Scientific Systems Company, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

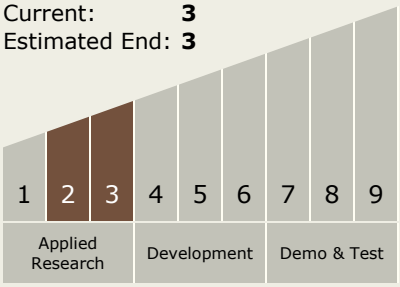
Carlos Torrez

Principal Investigator:

Jovan Boskovic

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Completed Technology Project (2012 - 2012)

Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.1 Situational and Self Awareness
    - TX10.1.2 State Estimation and Monitoring

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System